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by

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Innovative Hedging and Financial Services: Using Price Protection to Enhance the Availability of Agricultural Credit

Francesco Braga, Brian Gear[1]

The use of currency translated average rate options is shown to be a cost effective way to hedge corn and soybeans price risk in Ontario when the timing of the cash sales extends over several months. Standardized contracts incorporating the over-the-counter instrument may be developed, and could be offered as add-on to operating line of credit: lower average commodity prices would result in a reduced principal repayment obligation. Overall this would also lead to improved credit risk and lower cost of capital.

Introduction

Canadian lenders often do not consider farmers' hedging practices in their credit scoring process. This may result in a distorted credit classification of the borrower who may end up paying more for short term credit because of an underestimated credit rating. It is also true that not many farmers seem to be particularly fond of hedging, mostly for its perceived time and resource requirements. Rather well established among farmers is also the preference for flexible pricing strategies.

Overall, these considerations point to a potential problem. On one hand, the bank may be ignoring useful information which would allow a better risk classification; on the other, the farmer who does not hedge remains exposed to price risk and higher rates on borrowed funds. As a result, both the bank and the borrower may lose. In any case, it is most of the time true that a non hedged producer is a worse credit risk than a hedged one.

The idea that is considered here is the bundling of a standardized and simplified price protection package, that could be offered by the lender at a known up-front cost, with a competitively priced and highly simplified operating credit instrument. Farmers may be interested because of the convenience and actual lower cost of the package, while lenders may likely increase their market share, improve average credit quality and reduce administrative costs.

The empirical problem is whether, given current conditions, is it possible to utilize the financial innovations provided by over-the-counter average rate options to build such a package, with lower borrowing costs which in turn may cover -at least in part- the out of pocket cost of the option.

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Methodology

Conventional option pricing theory has been used to derive and compare premium for exchange traded options and two over-the-counter products: currency translated options (CTO) and Asian CTO. CTO are priced following Reiner (1992), and Asian CTO are priced according to Kemna and Vorst (1990), using the joint commodity and currency correlation calculated for the CTO. A CTO is an option struck on a domestic currency value of a foreign priced futures, for example the Canadian dollar value of a US corn futures price. This option combines protection against the commodity and currency risk, with a lower premium resulting from the less than perfect correlation between commodity and currency price changes. An Asian CTO is an option struck on the average value of a domestic currency value of a foreign priced futures, for example the average over a certain period of time of the Canadian dollar value of a US corn futures price. As an example, an Asian CTO put used in the simulation may provide protection against the average price in Canadian dollars of the March corn (or soybeans) futures falling below C$ 3.70/bu, over the August 1- February 28 period. This option offers further saving stemming from the lower volatility of the average price, compared with that of the individual price.

Canadian producers hedging with US priced instruments face both a commodity and a currency risk, hence the potential benefits of a CTO. An empirical application to Canadian cattle price risk has been documented by Braga (1997). The additional potential benefit of Asian CTO is linked to the extent that producers tend to spread their sales over a certain period of time. An empirical application to corn and soybeans producers in Ontario may be found in Gear (1996); this paper is a continuation of that work.

The empirical simulation begins with the strategy used to protect the 1988 harvest and ends with the strategy used to protect the 1995 harvest; in all, the simulation covers eight crop years. The Asian CTO put option is purchased early in the season, around planting time, and the result is evaluated at the end of the following February. Table 1 illustrates the timing of the Asian CTO strategies considered; 12 strategies were simulated, resulting from the combination of 3 beginning dates, April 1, May 1 and June 1, with 4 averaging periods, all ending on February 28 the following year.

The Asian CTO put premium for strikes ranging from 100% to 80% of the initial underlying were calculated using the implied volatility of the nearby commodity and currency futures, a zero correlation between the commodity and currency futures changes, and a constant 6% interest rate. These simplifying assumptions may reduce the accuracy of the results, although their likely effect is to increase rather than decrease the calculated cost of the strategy. In general, as of the start date of the strategy, the 20-day historical volatilities of May and July futures were higher than that of the futures expiring the following March. Interest rates are inversely related to premium values and have in any case a limited impact on the premium: a 1% change in interest rate translates in a 0.04% change in the premium of the Asian options with the longest averaging period. The impact of a 1% interest rate change on a conventional put option would be twice as large.

The payoff of the strategy, if any, was calculated using on the options' expiry, February 28 of the following year, by comparing the Asian CTO strike with the geometric average of the daily Canadian dollar value of the March commodity futures closing price, calculated at the March Canadian dollar

futures rate. Daily close prices were used.

Comparing Options Premium

Table 2 presents the premium for different at the money options all with life of 12 months, under different volatility scenarios. The "2 legs" strategy consists of the purchase of an exchange traded commodity futures put and a currency futures call. The "Currency Translated Option" (CTO) strategy consists of the purchase of a commodity futures put struck in Canadian dollars on the Canadian dollar value of a given commodity futures price, assuming that the correlation between commodity and currency futures price changes is 0. The "Asian" strategies consist of the purchase of an "Asian CTO", an average rate option struck on the Canadian dollar value of a given commodity futures price, with averaging beginning immediately, or after 3, 6 or 9 months. To illustrate, consider the case of an Asian CTO with a tenor to averaging of 9 months: the averaging period begins in 9 months and will last for the remaining 3 months before expiration.

Very simply, considering the middle row that would be representative of market conditions at the beginning of April 1998, a hedger purchasing a March 1999 at the money corn put and a March 1999 at the money Canadian dollar call would pay a premium corresponding to 10% of the initial underlying price. The corresponding hypothetical premium for a 0 correlation CTO is 8.7% of the initial underlying, or 1.3% less than the previous strategy. In the case of the Asian option, the premium is 7.9% of the initial underlying when the averaging is based on the last three months before expiration, but drops to 5.2% of the initial underlying when the averaging is based on the entire 12-month period.

The table underlines two points. First, the premium of the CTO is lower than that of the exchange traded options; second, a further decrease is observed with the Asian CTO. Generally speaking, the decrease in premium is more significant the closer the volatility of the two futures, the lower their correlation, and the longer the averaging period considered. Whereas the premium differences are substantial (e.g. premium is cut almost in half), it is important to recognize two crucial factors. First, practically in all market conditions the payoff of the different option strategies will differ. Generally speaking, the "2 legs" strategy will provide the richest payoff, followed by the CTO. The payoff of the Asian option is path-dependent, and is therefore affected by seasonal price patterns. In most market conditions, the Asian option with the longest averaging will provide the lowest payoff. Second, both the CTO and the Asian strategies are based on the assumed availability of an over-the-counter option, priced at zero correlation and without any consideration for bid-ask spread and other costs. This may be a rather optimistic assumption. As such, the results presented in the table are theoretically correct, but also only indicative, as they may be practically difficult to achieve even for a large player with a sophisticated financial infrastructure.

The exotic options' premium is lower than the premium of exchange traded ones. To the extent that the exotic option better matches the hedging needs of the client, then, one may be advised to select the exotic strategy over the exchange one. The Asian CTO strategy recognizes that the Canadian price risk is the result of a combined commodity and currency risk, and that most farmers, if possible, prefer to spread their cash transactions over a certain period of time, as opposed to selling the entire crop at harvest. In any case, OTC options will be priced off exchange traded instruments.

Simulation Results

Table 3.a presents the average cost of the Asian CTO for both corn and soybeans for the different strategies. Table 3.b presents the corresponding average payoff, net of premium cost. For example, the average cost of an at-the-money corn Asian CTO with averaging period April-February is 4.66% of the underlying value (table 3.a), whereas the average payoff of the same strategy, net of premium costs, is a positive 0.01% (table 3.b). As expected, the cost of the strategy increases for shorter averaging periods and decreases for lower strikes. The cost also increases when the starting date is later in the crop year.

In essence, table 3.b provides the marginal cost (if negative, saving if positive) of the given strategy, compared to the unhedged situation. Note that this number does not consider any gain from price increases. In a way, then, table 3.b presents the average cost of the strategy as a pure credit-risk enhancing instrument, that is the cost of "upgrading" from the retail client credit risk to the derivatives counter party credit risk, of course only for what pertains to the average futures price risk. As noted above, the payoff of an Asian option is path dependent, so that the results here should be interpreted only as the indication of an interesting potential, not as an exact measure. For example, the at-the-money option with 11-month averaging has an average cost of 4.66% of the initial underlying (tab 3.a). The average of the price decreases below the initial underlying is 4.67%, so that selection of the strategy leaves the user (4.67% - 4.66%) = 0.01% better off relative to the unhedged case. Another example, the 95% strike with the same averaging period costs on average 2.53%. This seems a substantial price saving relative to the at-the-money case, although one should not forget that this strikes only guarantees a price of 95%, that is this strike carries a 5% deductible on any loss. Since the average price drop, net of the 5% deductible, is 1.56%, the selection of the 95% strike leaves the user (2.53% - 1.56%) = 0.98% worse off when compared with the unhedged strategy.

The best results are obtained from the at-the-money-strike, and the results worsen with lower strikes. An early purchase in April or May, rather than a late purchase in June, is also preferred. This is likely the consequence of the sharp increase in the nearby implied volatility from April 1 and May 1 to June 1 that was observed for both corn and soybeans in 1988, 1992, 1994, and 1995, and that more than offset the decrease observed in 1989. The average nearby implied volatility for corn was 21.0% on April 1, 21.2% on May 1, and 26.6% on June 1. The corresponding values for soybeans are 19.4%, 20.5% and 25.7%.

The high prices during the Summer, corresponding to the weather-scare period, also may explain why, once the option has been bought early, it is preferable to select an August - February averaging period compared to a longer and therefore otherwise cheaper one. By the same token, post harvest price strength may explain the poor results observed for the December to February averaging period.

The results for a 85% and 80% strikes are not reported in the tables. Premium for these strikes is very low, ranging from a high of around 2.25% - 1.5% for short averages strategies starting in June to a low of less than 0.4% - 0.2% for long term averaging strategies beginning in April. These strikes carry a very high deductible, so that they only provide protection against extreme price drops. During the 8 years considered, the 80% strikes did not generate a payoff for corn, and a small payoff

was observed for some strategies in 1990 for soybeans. The 85% strike saw a payoff for some strategies in 1993 in the case of corn, and in 1990 and 1995 for soybeans.

A payoff that exceeded the initial premium for most of the 100%, 95% and 90% strikes was observed for most strategies in 1990, 1991, 1993 and 1995, for both corn and soybeans. Table 4 details the results for the 7-month averaging period for the three strategies starting in April, May and June. In the table, the first number indicates the number of times a payoff was observed, the second number the number of times the payoff exceeded the initial premium cost. From a practical standpoint these results confirm the deteriorating profitability of using low strikes already seen in table 3.b.

Implications

The key assumption of this study was that the credit scoring recognition of proper risk management could lower the cost of credit. However, risk management is not that common. Practical considerations suggest that the starting point, then, is to explore the potential of a standardized process that could be easily put in place and monitored by both the borrower and the lender. The need for standardization and simplifications is suggested by the desire to reduce administrative costs, including distribution, sales and monitoring, and by the need to "keep things simple" so that they may appeal to a broader segment of the potential clientele who may indeed be familiar with and attracted by the idea of price averaging.

The Asian CTO may offer some attractive features. Their premium is lower than that of existing exchange-traded options, thanks to the reduced volatility of the average price, and may better accommodate the timing of harvest and post-harvest sales of a large number of borrowers, therefore allowing for the needed standardization. This in turn may convince lenders to offer Asian CTO as an add-on to an existing credit product.

Information gathered through personal conversation with senior banking officials suggests that in most instances a proper price risk management strategy could result in an interest rate decrease of between 1 and 2%. More importantly, a proper price management strategy could also allow clients who currently use expensive trade credit to be considered for conventional bank credit, and this may result in a much higher borrowing cost decreases. The results presented in table 3.b indicate that, when compared to the unhedged case, the Asian CTO would, over a sufficiently long period of time (8 years in this simulation), pay for themselves or carry a reasonably low cost, in particular when at-the-money strikes are used. The point is whether or not the borrowing cost saving may be sufficient to offset this cost. Table 5 presents the actual saving accruing to a borrower from a nominal decrease in interest charged. The comparison of the value corresponding to the appropriate borrowing strategy with the relevant net payoff seen in table 3.b indicates to what extent the former may offset the latter. For example, consider a borrower who desires to borrow from April 1 to February 28, or for 11 months, 70% of the value of the underlying commodity, and who benefits from a 1% decrease in the nominal rate charged; the actual out of pocket saving will be 0.86% of the value of the initial underlying. This amount would have offset the cost of a 95% strike Asian CTO strategy with 7 month averaging period. Note that by the same token, an at-the-money Asian CTO would pay for itself, so that the reduction in borrowing cost could be considered an actual gain.

So far the analysis has considered only the commodity and currency futures price components of the cash price risk, ignoring basis and yield risk. These two may be easily handled using traditional instruments. This is important in order to provide the lender with a credit risk of sufficient quality.

Crop insurance is normally used to handle yield risk. Producers select the percentage of historical yield they want to insure; most frequently this percentage is 80%. Crop insurance payoff are based on the selected percentage of a farm's historical yield and on the average cash price at harvest time. Since it is rather unlikely for yields to fall below 80% of the historical average for the given farm, the purchase of crop insurance may point to a certain degree of risk aversion, which in turn may suggest the expectation of a good interest potential for the lending-price protection package being investigated. Forward basis contracts can be used to deal quite effectively with the basis risk. The empirical results of a forward basis sale at the time the Asian CTO strategy is initiated indicate that forward basis contract are an effective way to control basis risk, on average providing a forward basis value that is essentially identical, if not superior, to the realized harvest time cash basis (due to data limitation the simulation did not include 1988 and 1991 for corn, and 1990 and 1991 for soybeans). This result is important to reduce the price basis risk in a crop insurance payoff.

A portfolio including the cash commodity, the Asian CTO, a basis contract and crop insurance would likely be considered a good security for a loan. With crop insurance in place, the worst-case revenue is equal to the insured crop yield times the average cash price at harvest. In this simulation, the cash price is greater than or equal to the sum of the strike of the Asian CTO and the forward basis value, decreased by the "averaging mismatch", defined as the difference between the average of futures price calculated for the Asian CTO and the actual average of futures prices at harvest. The extent of this "averaging mismatch" is an empirical matter; a practical way to deal with it is to cap the amount that may be borrowed. Yield risk would be covered by the selected crop insurance percentage. Practically speaking, then, the lower bound for the security value of the portfolio including the commodity, the Asian CTO, the forward basis, and the crop insurance may be calculated by multiplying the sum of the initial underlying futures price and forward basis by the product of the historical yield, the percentage yield insured with crop insurance, the percentage of underlying protected by the Asian CTO strike and the coefficient used to address the "averaging mismatch" concerns. For example, consider a C$4/bu underlying, and a basis of 30 cents/bu under, a 125 bu/acre historical yield, 80% crop insurance, a 95% strike and a 95% "futures averaging mismatch" adjustment. The security value, would be greater than or equal to (4 - 0.30) x (125 x 0.8 x 0.95 x 0.95) = C$333.93/acre.

An Illustration, Corn, April 1998

This example, illustrated in table 6, is based on marked conditions in mid-April, 1998. The March 1999 corn futures price, in C$/bu using the March 1999 C$ futures is approximately C$3.95/bu. Forward basis values are around C$0.25/bu under December futures, or approximately C$0.35 under March. Accordingly, the expected cash price at harvest is C$3.60/bu. Crop insurance is in place for 80% of the historical yield of 125 bu/ac. The "averaging mismatch" coefficient is arbitrarily set at 95%. Using a combined commodity and currency volatility for the CTO of 23% and a 5% risk free interest rate, the premium for the Asian CTO purchased on April 1 and expiring on February 28, 1999 with a 7-month averaging, would be: 6.48% for the 100% strike, 2.49% for the 90% strike, and

0.62% for the 80% strike, or C$0.26/bu for the C$3.95 strike, C$0.10/bu for the C$3.56 strike, and C$0.02 for the C$3.16 strike.

Assume that the borrower purchases the at-the-money strike for 26 cents/bu. The lowest bound that could be secured would be equal to 0.80 x 1 x 0.95 x (3.95 - 0.35) = C$ 2.74/bu, or approximately C$342/acre. If the loan remained outstanding for 10 months, and the decrease in interest rate were 2%, the saving generated would be approximately 5 3/4 cents/bu, or about 22% of the Asian CTO premium. Under this scenario, and compared with the unhedged condition, the producer would likely have access to more credit and save up to 5 3/4 cents/bu in borrowing costs. Similar calculations for the 90% strike call for a borrowing of approximately C$308/acre, a premium of 10 cents/bu and a borrowing cost saving of about 5 cents/bu. With the 80% strike the producer may borrow up to C$274/acre, pay 2 cents/bu and save up to 4 ½ cents/bu in borrowing costs.

Conclusions

The empirical results confirm the potential benefits of Asian CTO. Although it would be naive to ignore the substantial practical questions still remaining, the suggestion of a simplified and standardized approach with large lenders offering Asian CTO as an "add-on" to operating credit products may actually work and benefit both the borrower and the lender. From a risk management standpoint, the premium of an Asian CTO may be only one half of the premium of exchange traded options. To the extent that the user is exposed to an average price risk, for example resulting from selling a percentage of the crop at different times during the year, it is possible to suggest that an Asian CTO strategy would be a simpler and more economical choice than the purchase of exchange traded options. Benefits are not limited to price risk management alone. A beginning and low equity borrower may purchase a better credit rating through a combination of basis contracts, Asian CTO and crop insurance. This results in access to more credit at lower rates, and these benefits are in addition to the actual reduction in price risk, thereby underlining an additional benefit of proper risk management. If credit risk enhancement is the main objective of this strategy, a low strike may be purchased with the saving from the reduction in borrowing costs. From a risk management standpoint, however, better results may be obtained from higher strikes, due to the high deductible implied by the out-of-the-money strike.

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Table 1: Averaging period considered by the Asian CTO strategies used in the simulation.

April 1 start date	May 1 start date	June 1 start date
April - February	May - February	June - February
August - February	August - February	August - February
October - February	October - February	October - February
December - February	December - February	December - February

Table 2: Comparison of initial premium cost for different at the money year option, with a 5% risk free rate and 0 correlation between the two futures.

Volatility		Exchange Traded "2 Legs"	Currency Translated Option	Asian Currency Translated Option with averaging starting			
Fut.1	Fut.2			in 9 months	in 6 months	in 3 months	immediately
17.5%	3.0%	7.8%	6.7%	6.2%	5.5%	4.8%	4.0%
22.5%	4.0%	10.0%	8.7%	7.9%	7.2%	6.3%	5.2%
27.5%	5.0%	12.3%	10.6%	9.7%	8.8%	7.7%	6.4%

Table 3.a: Average cost of the Asian CTO with different starting date and averaging period, 1989-1996.

Starting date	Strike, as % of underlying	Corn				Soybeans			
		11-mo[a]	7-mo	5-mo	3-mo	11-mo[a]	7-mo	5-mo	3-mo
April	100%	4.66%	6.02%	6.59%	7.10%	4.31%	5.58%	6.10%	6.58%
	95%	2.53%	3.79%	4.32%	4.81%	2.22%	3.38%	3.87%	4.32%
	90%	1.19%	2.18%	2.62%	3.04%	0.96%	1.84%	2.25%	2.63%
	100%	4.49%	5.61%	6.23%	6.79%	4.36%	5.44%	6.04%	6.58%
	95%	2.38%	3.40%	3.98%	4.50%	2.26%	3.25%	3.81%	4.31%
	90%	1.07%	1.85%	2.33%	2.77%	0.99%	1.74%	2.19%	2.62%
	100%	5.36%	6.35%	7.19%	7.94%	5.20%	6.16%	6.98%	7.70%
	95%	3.15%	4.08%	4.88%	5.58%	3.02%	3.92%	4.68%	5.37%
	90%	1.68%	2.43%	3.11%	3.73%	1.61%	2.32%	2.97%	3.57%

[a] The period is 10 months for the May start date and 9 months for the June start date.

Table 3.b: Average payoff of the Asian CTO, net of options payoff, with different starting date and averaging period, 1989-1996.

Starting date	Strike, as % of underlying	Corn				Soybeans			
		11-mo[a]	7-mo	5-mo	3-mo	11-mo[a]	7-mo	5-mo	3-mo
April	100%	0.01%	0.49%	-0.01%	-0.85%	0.11%	0.60%	0.44%	0.05%
	95%	-0.98%	-0.41%	-0.87%	-1.68%	-0.16%	-0.05%	-0.07%	-0.22%
	90%	-1.12%	-1.34%	-1.73%	-2.36%	-0.39%	-0.38%	-0.45%	-0.88%
May	100%	0.37%	0.63%	0.08%	-0.77%	1.18%	1.42%	1.17%	0.69%
	95%	-0.22%	0.25%	-0.28%	-0.98%	0.44%	0.63%	0.64%	0.41%
	90%	-1.00%	-0.70%	-1.13%	-1.75%	-0.04%	-0.16%	-0.22%	-0.30%
June	100%	-0.07%	-0.08%	-0.88%	-1.79%	0.57%	0.68%	0.68%	0.26%
	95%	-0.09%	-0.19%	-0.93%	-1.84%	-0.56%	-0.75%	-0.78%	-1.16%
	90%	-0.49%	-0.42%	-1.03%	-1.86%	-0.96%	-1.13%	-1.62%	-2.12%

[a] The period is 10 months for the May start date and 9 months for the June start date.

Table 4: Number of times a payoff was observed (a), and a payoff exceeded the premium paid (b), for 7-month averaging strategies, 1989 - 1996.

Strike used	Corn						Soybeans					
	April		May		June		April		May		June	
	a	b	a	b	a	b	a	b	a	b	a	b
100%	5	5	5	4	4	3	5	3	5	4	6	5
95%	5	3	4	4	3	3	3	3	4	4	5	2
90%	2	2	4	2	3	3	3	2	3	1	2	2

Table 5: Borrowing cost savings accruing from a decrease in the nominal rate.

Reduction in nominal rate charged	Amount borrowed, as % of underlying	Period of time the loan remains outstanding (months)					
		11	10	9	7	5	3
2%	70%	1.28%	1.17%	1.05%	0.82%	0.58%	0.35%
	50%	0.92%	0.83%	0.75%	0.58%	0.42%	0.25%
	25%	0.46%	0.42%	0.38%	0.29%	0.21%	0.13%
1%	70%	0.86%	0.78%	0.70%	0.54%	0.39%	0.23%
	50%	0.61%	0.56%	0.50%	0.39%	0.28%	0.17%
	25%	0.31%	0.28%	0.25%	0.19%	0.14%	0.08%

Table 6: Illustration for April 1998 market conditions

Market conditions

Corn March 99 futures	C$ 3.95/bu
Forward basis	C$ 0.35/bu under
Expected cash price	C$ 3.60/bu
Crop insurance	80% of historical yield of 125 bu/ac
"Averaging Mismatch"	95%

Asian CTO premium,

100% Strike, C$3.9500/bu, Premium C$0.26/bu (or 6.48% of underlying)
90% Strike, C$3.56/bu, Premium C$0.10/bu (or 2.49% of underlying)
80% Strike, C$3.16/bu, Premium C$0.02/bu (or 0.62% of underlying)

Lowest security value with Asian CTO and crop insurance

100% strike: (C$3.95/bu - C$0.35/bu) x 0.80 x 0.95 x 1.00 x 125 bu/ac = C$342.00/acre.
90% strike: (C$3.95/bu - C$0.35/bu) x 0.80 x 0.95 x 0.90 x 125 bu/ac = C$307.80/acre.
80% strike: (C$3.95/bu - C$0.35/bu) x 0.80 x 0.95 x 0.80 x 125 bu/ac = C$273.60/acre.